

mean RR interval < 700 ms had a 45% sensitivity and 20% positive predictive accuracy.

Conclusion: PredischARGE 24-hour mean heart rate is a strong predictor of mortality after myocardial infarction, than can compete with HRV and LVEF.

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737-4 Autonomic Nervous System Activity in Daily Life in Patients With Neurally Mediated Syncope: The Assessment of Heart Rate Variability From 24-Hour Holter Monitoring

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Autonomic function plays an important role in the pathogenesis of neurally mediated syncope (NMS). Heart rate variability (HRV) indices derived from 24-hour Holter monitoring (H) reflect the autonomic control of the heart in daily life. To investigate whether the daily autonomic function differs in patients (pts) with and without NMS, we performed H and measured HRV indices in 50 pts (39 \pm 20 years) with clinically suspected NMS (CSNMS) and 50 age-matched normal controls (CTL). Pts with organic heart diseases affecting HRV values such as congestive heart failure, coronary artery disease, diabetics were excluded from this study. For HRV assessment, time domain analysis including mean RR (ms), SDNN (ms), SDANN (ms), SD (ms), rMSSD (ms), pNN50 (%) and frequency domain indices (low frequency, 0.04–0.15 Hz, LF, ms; high frequency, 0.15–0.40 Hz, HF, ms) were measured. Within 48 h of H, head-up tilt testing (HUT, 40 min, 80° tilt) was undertaken in pts with CSNMS. Among pts with CSNMS, 29 pts had a positive HUT (P pts) while 21 pts had negative test (N pts). We considered P pts as a definite NMS and N pts as a possible NMS. Results were shown below.

	Mean RR	SDNN	SDANN	SD	rMSSD	pNN50	LF	HF
P pts	847 \pm 112*	177 \pm 44*	166 \pm 44	62 \pm 16*	39 \pm 19	16 \pm 13*	25 \pm 7	16 \pm 7*
N pts	883 \pm 87*	150 \pm 47	135 \pm 42	58 \pm 32	36 \pm 23	11 \pm 14	21 \pm 14	14 \pm 8
CTL	779 \pm 71	134 \pm 42	135 \pm 82	52 \pm 12	30 \pm 10	8 \pm 6	34 \pm 6	13 \pm 5

mean \pm SD, *p < 0.05 vs CTL

Values of mean RR, SDNN, SD, pNN50 and HF in P pts were significantly higher than those of CTL. Also, SDANN and rMSSD had similar trends. These tendencies were observed between N pts and CTL. **Conclusion:** NMS pts have augmented autonomic activities in daily life, especially elevated vagal tone, since pNN50 and HF mainly reflect vagal activity.

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737-5 How Many Parameters are Really Needed for the Analysis of Heart Rate Variability?

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Numerous Holter derived parameters of heart rate variability (HRV) have been proposed for measuring the different aspects of the autonomic nervous system. However, it is questionable whether such a large number of parameters is really needed to describe HRV. Therefore, we studied the latent structure of HRV in 66 normals and in 322 post MI pts at discharge. The following time domain parameters from Holter recordings were evaluated using cluster and principal components analysis: mean NN interval, SDNN, SDANN, SDNN idx, coefficient of variation (CV), triangular index (TRI), width of histogram, rMSSD, NN50, pNN50, and the day/night difference (DIFF). **Results:** Cluster analysis revealed mean interval as an independent parameter, followed by 2 clusters representing short-term variability (rMSSD, NN50, pNN50, SDNN idx, CV) and circadian changes (SDNN, SDANN, TRI, Width, DIFF). Principal components analysis resulted in a 3 dimensional structure: factor 1 explaining 65% of total variance was represented by SDNN idx and can be interpreted as short-term variability, factor 2 explaining 21% was represented by DIFF adjusted for rMSSD and stands for the circadian changes, factor 3 explaining 5% was best represented by the mean interval after adjustment for CV. Post MI pts. showed a lower circadian HRV and shorter mean cycle lengths in comparison to normals. No differences in short-term HRV were found. The prognostic value for cardiac death within 2 yrs after MI was best for HRV parameters describing the circadian profile of HRV. **Conclusion:** Time domain HRV parameters are redundant. They can be grouped in three clusters, representing mean cycle length, circadian pattern, and short-term variability. HRV can be described completely by using only 3 parameters.

737-6 Exercise Training Increases Heart Rate Variability in Normal Older Adults

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Analysis of heart rate variability (HRV) from 24-hr Holter recordings offers a useful non-invasive technique for assessing changes in cardiac autonomic tone in response to exercise training. Although highly fit individuals have high HRV, the effect of exercise training on autonomic tone in older adults has not been fully explored. 17 adults (7 M, 10 F, 67 \pm 4 yrs) completed 12 mos of supervised exercise, 3 mos of stretching and 9 mos of one hr/day, 5 days/week aerobic exercise at \approx 70% of maximal oxygen uptake. 24-hr Holter recordings were obtained shortly before beginning aerobic exercise and upon completion of the program. In addition, control recordings were obtained on a similar group of 16 normal older adults (7 M, 9 F, 66 \pm 4 yrs) at baseline and after one year. Increase in maximal oxygen consumption, for the exercise subjects [1.8 \pm 0.5 L/min (pre); 2.2 \pm 0.7 L/min (post)] was significant, p < 0.05. Results for indices of heart period and HRV are shown below. No other index of HRV was significantly affected by the exercise program.

	Training		Controls	
	pre	post	pre	post
AVGNN (ms)				
24 hr	787 \pm 45	823 \pm 68	821 \pm 106	832 \pm 97
Daytime	726 \pm 41	752 \pm 75	752 \pm 105	763 \pm 100
Nighttime	906 \pm 81*	961 \pm 75*	968 \pm 113	973 \pm 98
SDNN (ms)	126 \pm 21*	142 \pm 25*	135 \pm 32	134 \pm 32
SDANN (ms)	116 \pm 21*	129 \pm 23*	126 \pm 32	123 \pm 32

*Indicates significant difference by paired t-test, p < 0.05.

Conclusion: Exercise training increases total HRV in normal older adults, primarily by reducing heart rates at night. Other indices which reflect parasympathetic or mixed sympathetic and parasympathetic tone are not affected by exercise training.

738 Basic Mechanisms of Field Stimulation and Defibrillation

Tuesday, March 26, 1996, 8:30 a.m.—10:00 a.m.
Orange County Convention Center, Room 209

8:30

738-1 Defibrillation Using Multiple Pathway Shocks With Rotational Field Gradients

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The effect of an electric field gradient to stimulate or extend the refractoriness of myocardial tissue depends, in part, on the alignment of the electric field with the myocardial muscle fibers. Because muscle fiber changes orientation by 180 degrees from endocardium to epicardium, a field that is aligned along fibers at one site may be poorly aligned at a nearby site. We hypothesized that a shock with a field gradient that rotated with time could improve defibrillation by permitting better alignment with all fibers for at least some portion of the shock. In 4 pentobarbital anesthetized dogs, we used two arbitrary waveform defibrillators to simultaneously deliver shocks to orthogonal pairs of epicardial disk electrodes. The defibrillators produced current controlled sine and cosine waveforms with the same peak currents. A voltage gradient vector was measured in the mid-anterior LV to confirm that local fields rotated with time. Energy for 50% defibrillation success (E_{50}) was measured using waveforms with 4, 8, and 16 ms durations that rotated by 90, 180, and 360 degrees. E_{50} s for 8 ms rectangular control shocks to the A (8.33 \pm 5.18 J) or B (9.45 \pm 3.76) pathways were also measured and the A controls was used to normalize other E_{50} s (mean \pm SD).

Duration	90 deg	180 deg	360 deg
4 ms	0.51 \pm 0.08	0.41 \pm 0.02	0.49 \pm 0.09
8 ms	0.46 \pm 0.08	0.55 \pm 0.09	0.48 \pm 0.08
16 ms	0.72 \pm 0.27	0.52 \pm 0.08	0.51 \pm 0.11

Normalized E_{50} s did not vary among rotating waveform types (anova, p = 0.07) and were roughly half of that required using A (or B) pathways alone.

We conclude that the rotational waveforms significantly reduced defibrillation energy. This reduction could be due to the use of multiple shock pathways, to biphasic field gradients along some fiber directions, to a better